REMARKS

This amendment is responsive to the final official action mailed April 26, 2004, Paper No. 8.

Upon entry of this amendment, claims 1-8 are pending. Claims 1-4 have been amended and new claim 8 has been added. Support for the new claim can be found, for example, at paragraphs 46-47 and Fig. 5. No new matter has been added.

In the official action, the examiner:

- objected to claims 1-3 as being informal,
- rejected claim 3 under 35 U.S.C. § 112(¶2) as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention,
- rejected claims 1, 3, 4 and 5 under 35 U.S.C. § 120(b) as being anticipated by U.S. Patent No. 5,926,389 to Trounson ("the Trounson patent"),
- rejected claims 2, 6 and 7 under 35 U.S.C. § 103(a) as being unpatentable over the Trounson patent in view of U.S. Patent No. 5,808,893 to Pugh ("the Pugh patent"),
- withdrew the previous objections to the drawings, specification, and claim 2 in view of the drawing correction and amendments submitted on March 8, 2004,

Objections

The examiner objected to claims 1, 2 and 3 as having various informalities. In particular, claim 1 was objected for reciting "control command," where it should recite "control commands." Claims 2 and 3 were objected to for reciting "time parameter type polynomial," where they should recite "time parameter polynomial,"

Claims 1, 2 and 3 have been amended to incorporate the examiner's suggested corrections, thus applicants request these objections be withdrawn.

Rejections

35 U.S.C. § 112(¶2)

The examiner rejected claim 2 under 35 U.S.C. § 112(¶2) as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. Specifically, the phrase "at the time in the future when said object to be controlled has not yet moved on the basis of said time parameter type polynomial," is not understood. The relative times of when the position and velocity are computed, when the object moves and when the commanding action is executed are not clear. Furthermore, the phrase "the time in the future" lacks antecedent basis.

Claim 3 has been amended to recite:

> "... said control command is executed by computing a position and velocity at a time in the future, wherein when said control command is executed, said object to be controlled has not yet moved on the basis of said time parameter polynomial."

Thus, claim 3 now recites the relative times at which position and velocity are computed in relation to when the object to be controlled is moved. Applicants therefore request that the rejection of claim 3 under 35 U.S.C. § 112(¶2) be withdrawn, and that the claim be allowed.

35 U.S.C. § 102(b)

The examiner rejected claims 1, 3, 4 and 5 under 35 U.S.C. § 102(b) as being anticipated by the Trounson patent.

Claims 1 & 3

Claim 1 has been amended to recite, *inter alia*,

> "A numerically controlled method of moving an object to be controlled along a predetermined locus ... comprising:
> approximating said locus by defining a spatial polynomial in a work space, said spatial polynomial having a parameter λ which is not dependent on time;
> converting parameter λ of said spatial polynomial to insert a time variable t function, thereby obtaining a time parameter polynomial defining position as a function of time;

producing a position command, a velocity command and an acceleration command from said converted time parameter polynomial;

converting and delivering said produced position command, said velocity command and said acceleration command to said respective control axes in said joint space;

producing control commands for said respective control axes in said joint space from said position command, said velocity command, and said acceleration command on the basis of said time parameter polynomial, converted and distributed to said control axes in said joint space; and

moving said object to be controlled along said locus, while controlling said respective control axes in said joint space on the basis of said control commands"

The Trounson patent does not anticipate claim 1 because it does not disclose, teach or suggest "... obtaining a time parameter polynomial defining position as a function of time; producing a position command, a velocity command and an acceleration command from said converted time parameter polynomial; converting and delivering said produced position command, said velocity command and said acceleration command to said respective control axes in said joint space; producing control commands for said respective control axes in said joint space from said position command, said velocity command, and said acceleration command on the basis of said time parameter polynomial, converted and distributed to said control axes in said joint space; and moving said object to be controlled along said locus, while controlling said respective control axes in said joint space on the basis of said control commands."

Rather, the Trounson patent discloses a system in which particular values for position, velocity, acceleration and jerk are stored in "Path Tables" in the memory of the microprocessor. (*See* Trounson patent, col. 6, lines 35-37 and Fig. 5). The path table (or tables) contain six values for each of the desired four parameters of desired position, velocity, acceleration and jerk. (*Id.* at col. 7, lines 64-66 and Fig. 5). A recursive addition process is used to compute successive object positions by, for example, adding the velocity value **36** for the axis under control to the position value **34**, adding the acceleration value **38** to the velocity value **36**, and adding the jerk value **34** to the acceleration value **38**. (*Id.* at col. 8, lines 1-6). After 100 cycles of a control count, an algorithm is used to compute new position, velocity, acceleration and jerk values. (*Id.* at

col. 7, lines 28-31). Thus, the Trounson patent uses the intermediate step of calculating values from a polynomial, placing those values in a "path table," then using a recursive addition process to control object movement. The present invention, as recited in amended claim 1, produces a position command, a velocity command and an acceleration command directly from said converted time parameter polynomial.

In view of the above, applicants request that the 35 U.S.C. § 102(b) rejection of claim 1 be withdrawn, and that the claim be allowed. With respect to claim 3, which depends from claim 1 and recites additional features of the invention, applicants request that this claim be allowed for the same reasons identified with respect to claim 1. With respect to new claim 8, which also depends from claim 1 and recites additional features of the invention, applicants request that this claim be allowed for the same reasons identified with respect to claim 1.

Claims 4 and 5

Claim 4 has been amended to recite, *inter alia*,

> "A method for controlling an object in a work space ... comprising: defining a spatial locus of the object including a line in the work space, wherein the line is approximated by a spatial polynomial ... independent of time ... converting said spatial polynomial to a motion polynomial by replacing said spatial variable with the time function ... producing a position command, a velocity command and an acceleration command from said converted motion polynomial; converting and distributing motions defined by the motion polynomial over the plural control axes, each of the control axes having a corresponding axis motion as a function of time; and controlling the plural control axes according to said position command, said velocity command, and said acceleration command."

The Trounson patent does not anticipate claim 4 because it does not disclose, teach or suggest "... defining a spatial locus of the object including a line in the work space, wherein the line is approximated by a spatial polynomial ... independent of time ... converting said spatial polynomial to a motion polynomial by replacing said spatial variable with the time function ... producing a position command, a velocity command and an acceleration command from said converted motion polynomial; converting and

distributing motions defined by the motion polynomial over the plural control axes, each of the control axes having a corresponding axis motion as a function of time; and controlling the plural control axes according to said position command, said velocity command, and said acceleration command."

Rather, as stated above in relation to claim 1, the Trounson patent discloses a system in which particular values for position, velocity, acceleration and jerk are stored in "Path Tables," which contain values for each of the desired four parameters of desired position, velocity, acceleration and jerk. (*See* Trounson patent, col. 6, lines 35-37; col. 7, lines 64-66 and Fig. 5). Thus, the Trounson patent uses the intermediate step of calculating values from a polynomial, placing those values in a "path table," then using a recursive addition process to control object movement. The present invention, as recited in amended claim 4, produces a position command, a velocity command and an acceleration command directly from said converted motion polynomial, where the motion polynomial is a function of time.

In view of the above, applicants request that the 35 U.S.C. § 102(b) rejection of claim 4 be withdrawn, and that the claim be allowed. With respect to claim 5, which depends from claim 4 and recites additional features of the invention, applicants request that this claim be allowed for the same reasons identified with respect to claim 4.

35 U.S.C. § 103(a)

The examiner rejected claims 2, 6 and 7 under 35 U.S.C. § 103(a) as being unpatentable over the Trounson patent in view of the Pugh patent.

Claim 2

Claim 2 depends from claim 1, and thus contains all of the limitations of that claim. As stated above in relation to amended claim 1, the Trounson patent does not disclose, teach or suggest "... obtaining a time parameter polynomial defining position as a function of time; producing a position command, a velocity command and an acceleration command from said converted time parameter polynomial; converting and delivering said produced position command, said velocity command and said acceleration command to said respective control axes in said joint space; producing control commands for said respective control axes in said joint space from said position

command, said velocity command, and said acceleration command on the basis of said time parameter polynomial, converted and distributed to said control axes in said joint space; and moving said object to be controlled along said locus, while controlling said respective control axes in said joint space on the basis of said control commands," as required by claim 1. The Pugh patent does not remedy this deficiency. Rather, the Pugh patent discloses converting time-based trajectory parameters into cycle-based parameters. (*See* Pugh patent, col. 10, lines 41-46). Trajectory parameters with units of time (seconds) are converted to units of "cycles" by dividing by the nominal machine-cycle period (seconds/cycle). (*See id.*, col. 10, lines 50-52). During trajectory execution, the actual camshaft state **92** (position in cycles, velocity in cycles/second, and acceleration in cycles/second^2) is used, together with the converted trajectory parameters to obtain corrected turret velocity and acceleration. (*See id.*, col. 10, lines 60-67 to col. 11, lines 1-8). Thus, like the Trounson patent, the Pugh patent uses an intermediate step during path execution. The present invention, as recited in amended claim 1, produces a position command, a velocity command and an acceleration command directly from said converted time parameter polynomial.

Thus, for the above reasons, applicants request that the 35 U.S.C. § 103(a) rejection of claim 2 be withdrawn and that the claim be allowed.

Claims 6 & 7

Claims 6 and 7 depends from claim 4, and thus contain all of the limitations of that base claim. As stated above in relation to amended claim 4, the Trounson patent does not disclose, teach or suggest "... defining a spatial locus of the object including a line in the work space, wherein the line is approximated by a spatial polynomial ... independent of time ... converting said spatial polynomial to a motion polynomial by replacing said spatial variable with the time function ... producing a position command, a velocity command and an acceleration command from said converted motion polynomial; converting and distributing motions defined by the motion polynomial over the plural control axes, each of the control axes having a corresponding axis motion as a function of time; and controlling the plural control axes according to said position command, said velocity command, and said acceleration command," as required by

claim 4. The Pugh patent does not remedy this deficiency. Rather, the Pugh patent discloses converting time-based trajectory parameters into cycle-based parameters. (*See* Pugh patent, col. 10, lines 41-46). Trajectory parameters with units of time (seconds) are converted to units of "cycles" by dividing by the nominal machine-cycle period (seconds/cycle). (*See id.*, col. 10, lines 50-52). During trajectory execution, the actual camshaft state 92 (position in cycles, velocity in cycles/second, and acceleration in cycles/second^2) is used, together with the converted trajectory parameters to obtain corrected turret velocity and acceleration. (*See id.*, col. 10, lines 60-67 to col. 11, lines 1-8). Thus, like the Trounson patent, the Pugh patent uses an intermediate step during path execution. The present invention, as recited in amended claim 4, produces a position command, a velocity command and an acceleration command directly from said converted motion polynomial, where the motion polynomial is a function of time.

Thus, for the above reasons, applicants request that the 35 U.S.C. § 103(a) rejection of claims 6 and 7 be withdrawn and that these claims be allowed.

Every effort has been made to present the subject matter of the application in proper form, to particularly and distinctly define the subject matter regarded as the invention and to demonstrate that the subject matter claimed as a whole is properly patentable over the prior art. The disclosure and claims as amended are in condition for allowance. Reconsideration and allowance are requested.

Respectfully submitted, Reg. No. 55,044

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